



MATERIAL ECONOMICS

SCALING UP EUROPE

Bringing Low-CO₂ Materials from Demonstration to Industrial Scale

Commissioned by

 **Breakthrough Energy**

EXECUTIVE SUMMARY

Low-CO₂ materials – steel, cement, chemicals and more – are indispensable for EU climate targets. They also are a massive economic opportunity for European industries, which can tap into an emerging global market that could reach 100 USD billion by 2030. European companies now lead in this space, with more than 70 industrial projects with breakthrough clean technologies planned across the continent. Yet for all the promising entrepreneurial activity, the policies and market conditions are not yet ready to seize this opportunity. The crucial step to industrial scale has yet to come, and final investment decisions are still pending. The EU and European countries urgently need to adopt a policy package and innovative financing mechanisms to put its heavy industries on a path towards net zero – and, in the process, secure European industrial competitiveness for decades to come.

EUROPEAN ENERGY-INTENSIVE INDUSTRIES ARE MAKING BOLD MOVES

Something big is afoot in European energy-intensive industries. The normally slow-moving sectors of steel, chemicals and cement are now abuzz with innovation. More than 70 projects have been announced just in the last two or three years to bring new, clean technologies and business models online. They aim to produce steel with hydrogen instead of coal; use recycled plastics as feedstock to make chemicals; pioneer new types of concrete with less than half the climate impact of today's products; and capture carbon from industrial processes to be stored permanently underground or reused to make high-value products. Together, these breakthrough technologies could transform industrial production in the EU.

The impetus for all this innovation is the EU's commitment to a low-CO₂ future. Companies know their current trajectory collides with EU climate targets: CO₂ emissions from energy-intensive industries have been stuck at around 650 Mt CO₂ for many years. To achieve deep emission reductions, they need to change the fundamentals of production: make steel, chemicals and cement with different feedstock, invest in new core capital assets and novel business models, and mobilise massive amounts of clean energy. After years of development, the key technologies are largely known and increasingly also ready to deploy. The challenge is to bring them to industrial scale in the real world.

European industry is rising to the challenge. The steel sector has its first major new entrants in several decades; more than a dozen start-ups are turning waste plastics into chemicals feedstock; companies want to launch entirely new concrete products; and technology companies are providing a wide range of novel solutions. Innovation is happening in all major EU regions, often through value chain collaborations between industrial companies and end-users. This could be a step-change for industry.

AN ECONOMIC OPPORTUNITY FOR EUROPE

Europe has every reason to support this effort to remake heavy industries. The steel, chemicals and cement sectors underpin value chains that together contribute as much as 14% of EU GDP and 7.4 million jobs. The current energy and geopolitical crisis only underlines the need to find a solid future basis for increased European strategic autonomy in basic materials. The same technologies that cut CO₂ also enable increased use of indigenous resources: renewable electricity, green hydrogen, and circular use of steel and plastics in place of imported ores, coal, oil and gas.

European industry can also benefit from a fast-growing new market for low-CO₂ materials. Already, thousands of companies, cities and other actors globally have committed to sharply reduce their CO₂ footprint under initiatives such as the Science-Based Targets and the First Movers Coalition. As these companies decarbonise their supply chains, we estimate that by 2030, the market for low-CO₂ steel, chemicals (including plastics) and cement will reach 100 billion USD. These buyers will reward innovators and trailblazers. Europe is now ahead in this market and can seize this opportunity to secure its lead and set the standards. However, other regions are starting to mobilise as well.

Europe should thus work to rapidly scale up breakthrough technologies: get the first-generation, industrial-scale plants online by 2025, and fully redirect capital flows towards new low-CO₂ technologies by 2030. By mobilising 45 EUR billion of investment, Europe could ramp up production to 25 Mt of steel, 5 Mt of high-value chemicals made from recycled plastic feedstock, and 70 Mt of concrete (equivalent to 10 Mt of cement) per year by 2030. To give a sense of the scale, in a single year, this would provide enough steel for 13 million cars, re-

cycled plastic for one in six pieces of plastic packaging, and enough concrete for some 700,000 million houses. The benefits would be massive, cutting 2030 emissions by 30 Mt CO₂ per year, creating 20 billion EUR worth of low-CO₂ materials, and positioning EU industry for global leadership.

EUROPE NEEDS TO ACT FAST TO CAPTURE THIS INDUSTRIAL OPPORTUNITY

Europe is not yet positioned to realise that potential, however. Stakeholders consulted for this study pointed to two concerns. First of all, projects currently in the pipeline are not enough to reach the needed scale. Only in steel are there proposals for large-scale projects across the sector. Second, final investment decisions on many of the proposed projects are still pending. Stakeholders are awaiting confirmation that the business case can work and that the necessary finance, energy supply and infrastructure can be put in place. Time is short: key investment decisions are due within two or three years.

Without change, Europe therefore is at risk of falling into old traps: leading in the early stages of technology development, but failing to follow through to scale. Stakeholders identified several challenges that need to be addressed. The current CO₂ prices are not effective in create revenues for clean production, so companies risk being left without an answer when investors ask how they will pay for new low-CO₂ investments. Early movers need to manage the risk of untested new technologies, and to overcome a powerful incentive to wait for others to take the first step. Producers and buyers alike need clear standards and transparency to define which materials are truly green, and a sufficient market pull to create the lead market on which new businesses can be built. Companies will need to obtain operating permitting for new facilities on timescales current systems struggle to achieve and need secure access to the new energy and infrastructure needed. Regulations need to be updated to ensure they do not keep innovations and new entrants out of the market.

In short, Europe must learn and act fast, or else this opportunity could be lost.

MAKING THE 2020S THE DECADE OF ACTION

The EU has a chance to solve these problems as part of the ongoing revamp of policy and regulations under the Green Deal and in response to new geopolitical and energy realities. If Europe wants to pursue the vision described above, it needs to adopt a clear vision for transforming heavy industry, at scale, and then develop a comprehensive, coherent policy agenda to achieve it. Our analysis identifies five key areas to address:

Pillar 1: Overcome the green cost premium and create lead markets. Especially for the first-of-a-kind projects, companies face a green cost premium of 100–150 EUR per tonne CO₂. While many see a clear route to competitiveness, the current lack of effective CO₂ prices for industry leaves a hole in the business case for clean industrial production. Proposed reforms to the EU Emissions Trading System, combined with carbon border adjustments, could address this in the long term, but likely not before the 2030s. An answer for the 2020s therefore is needed. Proposals under discussion include the free allocation of EU ETS allowances to non-emitters, subsidies such as carbon contracts for difference, and quotas for the use of recycled content in plastics. All told, we estimate a revenue gap in the range of 4–6 billion EUR per year by 2030. For comparison, annual support to biomass, wind and solar energy is 16–27 billion EUR each, while free allocation in the EU ETS is worth closer to 60 billion EUR per year.

Pillar 2: Enable investment for innovation. European companies must invest 40–50 billion EUR in industrial production to 2030 to scale up breakthrough technologies. First movers create tremendous value through reference plants and experience on which further scaling and innovation can be built. Yet they are rarely rewarded for this, and instead face large, often undiversifiable risks in bringing new technology and business models to market. This creates a powerful incentive to wait until costs fall and risks are smaller. Public support can go a long way to bridge the financing gap, and both the EU and European countries are exploring mechanisms such as capex grants, loan guarantees to mobilise private finance, and blended finance derisking approaches to enable a more favourable capital structure.

Pillar 3: Mobilise demand for green materials and chemicals. As noted, there is powerful latent demand for low-CO₂ products and value chains. Companies in automotive, packaging, construction and other sectors know that the additional cost even of fully decarbonised products can be minimal, often just 1–2% on the 2030 sales price, as the share of materials the total production cost of a complex product is often small. Policy can support this nascent market. Stakeholders pointed to a range of potential options: 2030 production targets for green materials that help coordinate supply and demand; ambitious standards that define and differentiate green, breakthrough materials and can underpin a market premium; and public and private initiative that drive demand for low-CO₂ materials, such as the limits for CO₂ content of construction materials now being introduced by some European countries.

Pillar 4: Provide the energy and infrastructure needed. Now more than ever, Europe clearly sees the value in mobilising its own energy and raw material resources. Industrial production is no exception. We estimate that scaling up industrial cleantech would require 90 TWh of additional low-CO₂ electricity, 20 TWh of low-CO₂ hydrogen, 10–15 Mt of storage capacity for industrial CO₂, and the effective recycling of another 10 Mt of plastic waste for use as feedstock in place of oil and gas. EU and national energy and infrastructure plans do not yet anticipate such large requirements. Europe needs climate and energy plans to serve the industrial clusters of the future, including prioritised access to clean hydrogen to reduce future reliance on imported gas by European steel and chemicals industries. A circular and bio-based raw materials strategy is needed to enable effective replacement of imported fossil energy and feedstock, and a CO₂ storage strategy that includes industrial needs.

Pillar 5: Adapt regulations for innovation at scale. Post-war Europe saw the build-out of the current industrial base and infrastructure, creating many of today's industrial champions. But since the 1980s, Europe has lost its appetite and capacity for ambitious new industrial capacity and infrastructure, with national regulations tuned for slow change but unsuited to rapid transformation. To succeed, stakeholders say a new regime and social contract is needed: permitting processes that are streamlined and more predictable, new products permitted to enter the market rather than held back by legacy product standards, and new regulatory frameworks created to build the new infrastructure required – from CO₂ storage to hydrogen pipelines.

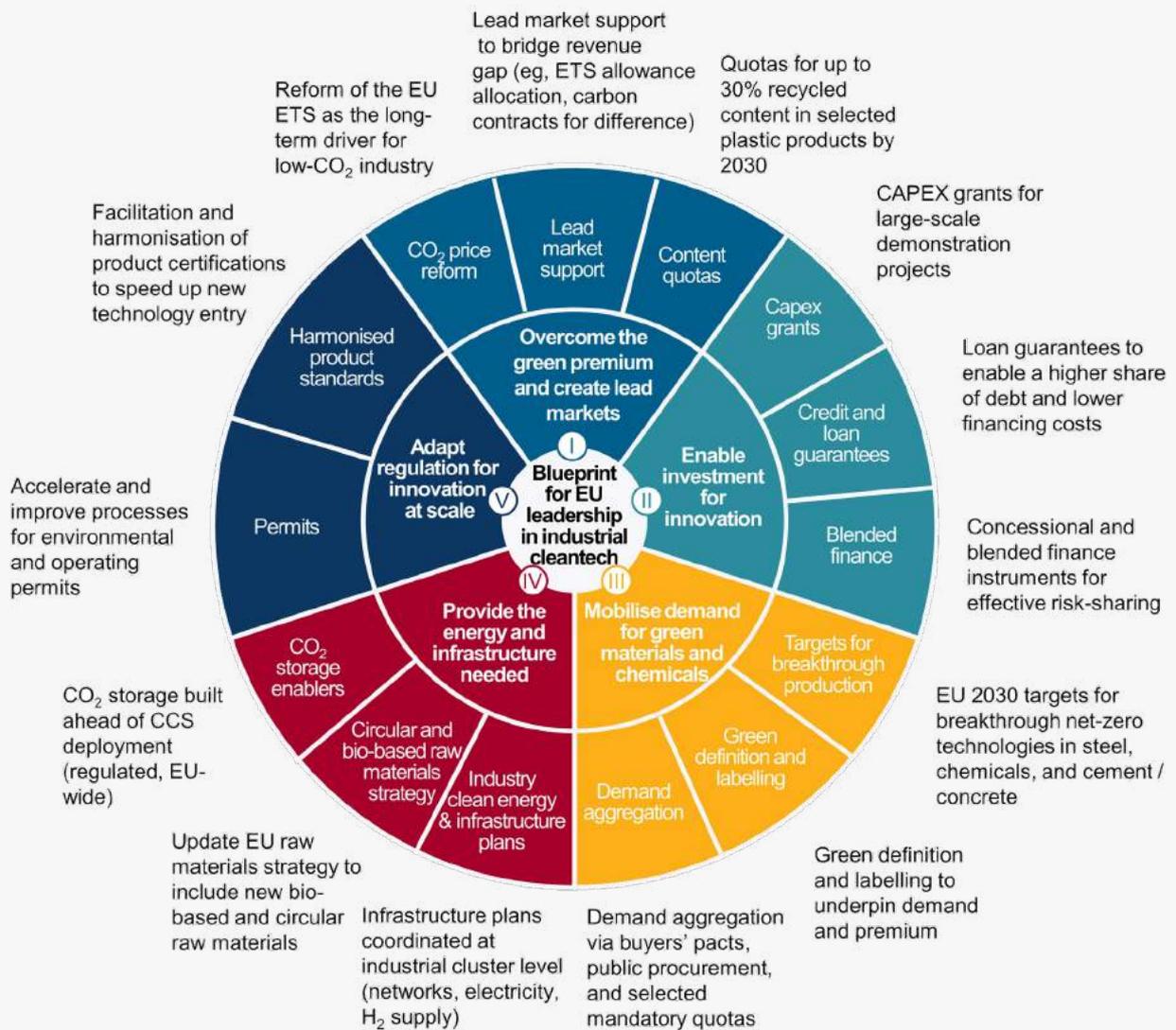
FAST-FORWARD TO THE FUTURE EUROPEAN INDUSTRY

The emergence of more than 70 breakthrough industrial projects in just a few years is truly inspiring. It provides line of sight to a competitive, low-CO₂, and much more autonomous future industry. There is every reason for optimism that a low-CO₂ transition will play to many European industrial strengths. European steel and chemicals companies have already gravitated towards high value-add niches over time, with innovation as the key antidote to other structural disadvantages such as higher energy or feedstock prices. The same skillset will be key to the low-CO₂ transition. Where Europe has succeeded in the past – such as in mobile telephony, pharmaceuticals and automotive – it has combined tightly integrated innovation systems, leadership in setting standards, and clusters of initial domestic demand that can form the base for scaling to global markets.

If Europe can apply the same formula to its basic materials industries, it can unlock a major economic opportunity for the next few decades.

Exhibit 1

FIVE PILLARS AND 14 INTERVENTIONS FOR EU INDUSTRIAL LEADERSHIP IN INDUSTRIAL CLEANTECH



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However, the crucial step to industrial scale has yet to come, with final investment decisions still pending. This study examines how the EU and European countries can act to put its energy-intensive industries on a path towards net zero – and, in the process, secure European industrial competitiveness for decades to come.

Disclaimer: The analysis and conclusions of this report are those of Material Economics. Material Economics is solely responsible for the contents of this report and the views are those of the authors

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